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Allelopathic Plants. 4. Common ragweed *(Ambrosia elatior* L. Syn *A. artemisiifolia)*

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ABSTRACT

The genus *Ambrosia* has more than 19 spp., all species are weeds and distributed in temperate and subtropical regions of the world. *Ambrosia artemisiifolia* is major weed and drastically reduces the crop yields. The weed produces 3000-62000 seeds per plant and is propagated only through the seeds, which remain viable for long periods. The weed significantly reduces the crop yields through interference. *A. artemisiifolia* is dominant spp. in the first two years of succession in uncultivated fields. The weed plants contain phenolic compounds and terpenes.

Keywords: Allelochemicals, *Ambrosia artemisiifolia*, crops, distribution, habitat, morphology, nematode management, research, succession, weeds.

1. INTRODUCTION

The genus *Ambrosia* includes many economically important weeds. *Ambrosia* species, viz., *A. bidentata, A. camphorata, A. cordifolia, A. coronifolia, A. cumanensis, A. grayi, A. maritima, A. paniculata, A. polystachya, A. tropacana* are minor weeds in many countries (Table-1). Of the 19 *Ambrosia* spp., only four *(A. cumanensis, A. artemisiifolia, A. psilostachya* and *A. trifida)* have shown allelopathic effects on some crops (1,15,24,25,28,29,31). Besides this, extracts of *A. maritima* possess molluscicidal

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activity (41) and *A. trifida* decreased the populations of several genera of plant parasitic nematodes in soybean fields (39).

Table 1. Distribution and Economic uses of Genus *Ambrosia*

S. No	Botanical name	English name	Economic use	Distribution
1.	*A. acanthicarpa* Hook Syn *Franseria acanthicarpa* Hook	Sand bur	P	North America
2.	*A. artemisifolia* L. Syn A. elatior L.	Common ragweed	Weed, P, Oil as food	N. S. America, Asia Europe, Australia*
3.	*A. bidentata*		Weed	**
4.	*A. camphor ata*			**
5.	*A.confertiflora* DC Syn *Franseria confertiflora* DC	Bur ragweed	Weed	North America
6.	*A. cordifolia*		Weed	**
7.	*A. coronifolia*		Weed	**
8.	*A.cumanensis*		Weed	**
9.	*A. grayi* (Nelson) Shiners Syn *Franseria tomentosa* Gray	Wooly leaf bur-rage	Weed	USA
10.	*A. hispida* Pursh		Medicinal	Mexico, Cuba
11.	*A. maritima* L.		Aromatic	Egypt
12.	*A. paniculata* Michx		CCTea	Florida, Antiles, India
13.	*A. peruviana* Wilid		Medicinal	Florida, W.India, Antiles, Cuba
14.	*A. polystachya*		Weed	
15.	*A. psilostachya* DC	Western ragweed Perrenial ragweed	Weed	North America, Europe, Australia
16.	*A. temifolia* Spreng	Lacy ragweed	Weed	Argentina, Brazil, Australia
17.	*A. tomentosa* Nutt Syn Franseria discolor Nutt	Skelton-leaf	Weed, P.	North America
18.	*A. trifida* L.	Giant ragweed	nematicidal	Mexico, USA, Japan, Canada, * every where
19.	*A. tropacana*		Weed	

Source: 34,37,40. P= Poisonous to animals, * Naturalised, ** Distribution not known, CC=Commonly cultivated.

Among *Ambrosia* species, the most common and widespread is *A. artemisiifolia* (common ragweed). It is native to North America and found in Canada, Europe, Asia and South America (36). It is the most abundant of the ragweeds and causes hay fever in eastern North America (3). The plant or its pollen may cause dermatitis and allergy in some people (19). Its extract at flowering stage stops local bleeding (4) and is bitter tonic for dyspepsia. Its

oil content is eqpal to soybean, but has better drying properties, thus used in paints or varnishes (32).

A. artemisiifolia is weed in crop fields, fallows and along roadsides in Ontario and Quebec in Canada (2). It infests all types of crops but very rare or absent in permanent pastures, lawns, marshes and woodlands (16). It is widespread on arable clay, silt and sand mixture soils with pH 6-7 (36). Its stiff, erect stem grows upto over 100 cm in height in fertile soils (20).

2. MORPHOLOGY AND FIELD OBSERVATIONS

A. artemisiifolia is an erect, 5-200 cm tall annual herb with a tap root. Stem is densely hairy, branched on upper part. Leaves short-stalked, hairy, ovate in outline, pinnated with 2-3 oblong-lanceolate, toothed or lobed segments on each side. Flower heads are dioecious, male flowers are hemispherical, dense in terminal racemes; female flowers are numerous and present in axils of upper leaves. There are 10-15 pale yellow flowers in each head. Flowering period is from August to October in Europe. It likes warmth and alternating temperatures for maximum germination. Alternating temperatures of 10/30 °C closely relate to field conditions of spring and early summer in Canada, where it is most abundant weed (2). It is primarily wind-pollinated and the number of seeds per plant may vary between 3000 and 62 000 (17). Its seeds remain viable for 39 years or more when buried in the soil (35). No vegetative reproduction is known. Common ragweed is able to adapt to mowing, trampling and grazing. Interspecific hybrid of *A. artemisiifolia* x *A. trifida (A. intergradiens* Wagner) has been found in several locations in Michigan. This hybrid often forms clonal populations that persist for many years (38).

3. ALLELOPATHIC RESEARCH

3.1. Bioassays

Till now, little information as under is available on allelopathy of *A. artemisiifolia*. The effects of water, acetone and alcohol extracts of leaves and shoots of *A. artemisiifolia* was studied on germination of pea, beans, corn and sunflower (6). Results indicated significant inhibition in germination and followed the order: beans > corn > sunflower >peas. The inhibition in beans was 75 to 80 %. Concentrated extracts caused more inhibition than diluted ones and acetone and alcohol extracts were more inhibitory than water extracts (Fig 1.) (6). In laboratory experiments, leaf extracts of *A. elatior* inhibited the germination of corn (27).

Bruckner and Molnar (12) demonstrated the allelopathic effects of *A. artemisiifolia* in germination bioassay with tissue culture. Calli induced from stem parts of cucumber 'Barbara', soybean 'McCall' and *Amaranthus retroflexus* were cultured on an extract free Murashige and Skoog (MSO) medium and an MS medium + 300 mg/kg^{-1} *A. artemisiifolia* leaf extract (MSA). In control, cucumber and *A. retrojlexus* calli were well developed with long branching roots, but the calli treated with *A. artemisiifolia* leaf extract were aborted, with significant reduction in weight and root number due to its allelopathic effects. However, no significant difference was found in bioassay with soybean. Calli grown on culture medium MSA were brown and necrotic, while the ones on MSO were green and yellow.

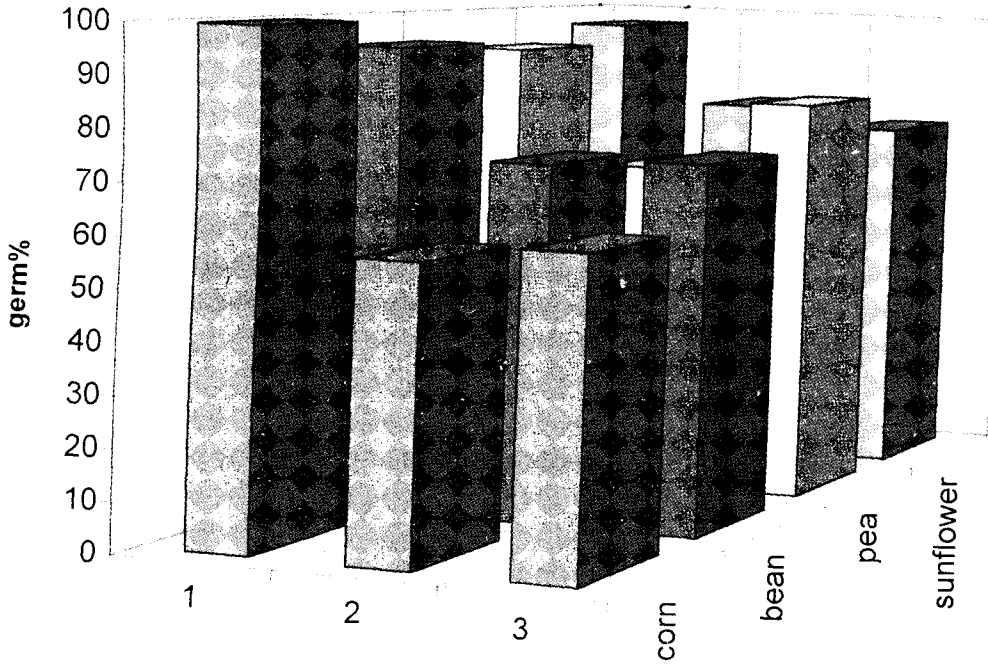

Fig. 1. Effect of *Ambrosia artemisifolia* shoot extracts [(control; alcohol extracts (66.6 gl^{-1}); acetone extracts (66.6g l^{-1}) on the germination of crops.] .LSD at 5%)

3.2. Field studies

3.2.1. *Crop interference.*

In field trials, the yield and value of flue-cured tobacco decreased with increasing duration of *A. artemisiifolia* infestation as compared to weed free plots. The critical weed density was found to be one *A. artemisiifolia* plants per 28 cm of row length (26).

Coble (13) studied the interference and the competitive ability of *A. artemisiifolia* in soybean at two locations. No significant reduction in crop yield was evident during the first 4 weeks exposure to the weed, but yields were reduced by more than 4 weeks of interference and continued to decrease as the time of exposure increased. Plots kept weed- free for < 4 weeks

showed decreased yields compared to other treatments. However, there was no advantage in maintaining the plots weed-free for > 4 weeks. Linear regression analysis of density studies showed that nine *A. artemisiifolia* plants/10 m row were required to significantly reduce the yields. In further investigations, the influence of *A. artemisiifolia* on the yield of soybean 'Ransom' was examined (14) using naturally occurring weed populations. The threshold density of *A. artemisiifolia* was 4 plants/10 m of soybean row, which reduced soybean yields upto 8%. In a dry year, soybeans kept weed-free for 2 weeks or longer after emergence produced optimum yields, while in a moist year soybeans had to be kept weed-free for 4 weeks to maintain optimum yields. Soybean yield was not reduced by non-removal of *A. artemisiifolia* upto 6 weeks or less after crop emergence. At eighth weeks after emergence, the average height of uncontrolled *A. artemisiifolia* was 25 cm greater than soybeans and the weed canopy intercepted 24% of photosynthetically active radiation (14). With a densitiy of 16 weeds/10 m row *A. artemisiifolia* caused 12% seed yield reduction in soybean (33).

Weeds have both inhibitory as well as stimulatory effects on the nutrient uptake of crop plants (28). Soil incorporated residues of *A. artemisiifolia* reduces the seedling growth of corn and soybean seedlings (9). *A. artemisiifolia* residues decreased the seedling growth of corn and soybean, but increased the K (21-48%) and P uptake in corn and not in soybean in a Biotron (Table 2) (8-10). Allelopathic activity however, did not appear to be associated with nutrient uptake. Temperature and photosynthetic photon flux density might alter the allelopathic effects of weeds on crops. In pot experiments, aqueous extracts of residues of *A. artemisiifolia* stimulated the growth of radicle and coleoptile in corn and hypocotyl in soybean. Various irrigation methods and soil types significantly influenced the allelopathic activity of other weeds (7).

Table 2. The effect of weed residues on nutrient uptake mg/plant in 28 days old corn and soybean plants

Weed species	Corn			Soybean		
	N	P	K	N	P	K
Control (no residue)	39.8	16.8	32.7	36.3	11.6	28.4
Chenopodium album	27.4	11.4	37.1	30.6	17.7	32.1
Amaranthus retroflexus	23.3	9.1	31.0	28.7	10.8	31.4
Ambrosia artemisiifolia	30.2	22.9	48.3	30.1	15.1	31.4
Abutilon theophrasti	31.3	12.9	35.4	30.7	11.5	28.8
Setaria glauca	23.2	12.6	39.7	25.2	12.5	29.7
LSD (0.05)	6.3	3.1	6.5	3.3	2.0	4.1

Source: 8,10,28

3.2.2. *Succession*

Jackson and Willemsen (22) and Beres and Pathy (5) observed that *A. artemisiifolia* is a dominant species on noncultivated and ruderal fields in the first year of field succession, but rarely persists for more than two years. It is an early invader, failed to become re-established in plots cleared of second stage perennial vegetation, despite the presence of large number of its seeds in the soil. The soil studies revealed that this pattern of succession was not due to mineral or physical properties of the soil, but field soil from the second stage of succession

inhibited the growth and germination of *A. artemisiifolia* and *Raphanus raphanistrum*, while soil from the first stage had no such effect. Inhibitory volatile materials from *A. artemisiifolia* were not detected. Root exudates and shoot extracts of *A. artemisiifolia* inhibited the germination and growth of early invaders of abandoned fields, indicating that the vegetational change from the first to the second stage of succession may be mediated partially by an allelopathic response (22). Numata *et al.* (30) studied the weed succession on waste lands and showed that *A. artemisifolia* is the first year pioneer plant followed by *Erigeron* spp. and *Solidago altissima.*

4. ALLELOCHEMICALS

4.1. Nature

Chromatography and bioassay techniques revealed that inhibitory compounds of *A. artemisiifolia* were phenolic acids, including caffeic and chlorogenic acids (22, Table 3).

Table 3. Allelochemicals identified from *A. artemisiifolia* plants

Name of compound	Reference
Sesquiterpene lactones	18
Caffeic acid, chlorogenic acid	19
Sesquiterpene hydrocarbons, methyl caffeate, P-sitosterol, stigmasterol	15
Sesquiterpenes	9
Polyacetylenes	20

Fischer and Quijano (18) isolated a mixture of sesquiterpene hydrocarbons, methyl caffeate and a mixture of β-sitosterol and stigmasterol as allelopathic agents from the roots of *A. artemisiifolia.* Mixed sesquiterpenes isolated from *A. artemisiifolia* strongly inhibited the germination of onion, oats, *Lolium* spp. and *Amaranthus palmeri* (11). Kobayashi *et al.* (23) reported that polyacetylenes occurring in *A. elatior* showed strong inhibitory effects on other plants.

REFERENCES

1. Anaya, A.L. and Del Amo, S. (1978). Allelopathic potential of *Ambrosia cumaneniss* H.B.K. (Compositae) in tropical Mexico. *Journal of Chemical Ecology* **4**: 289-304.
2. Bassett, I.J. and Crompton, C.W. (1975). The biology of Canadian weeds. 11. *Ambrosia artemisiifolia* L. and *A. psilostachya* DC. *Canadian Journal of Plant Science* **55**: 463-476.
3. Bassett, I.J. and Frankton, C. (1971). Hay fever from Canada havens. *Information Canada*, Ottawa, Ontario. 28 pp.
4. Bausor, S.C. (1937). A review of some medicinal plants. Part 2. Medicinal plants of our local flora. *Torreya* **37**: 45-54.
5. Beres, I. and Pathy, Zs. (1998). Common ragweed *(Ambrosia elatior).* In *Series* 24. *Common Weeds of Hungary and Protection Against Them.* (Eds., I. Csibor, F. Hartmann, G. Princziner and H. Radvany) pp. 59-67. Szekszard, Hungary: Mezofbldi Agroforum Kft.

6. Beres, I., Sardi, K. and Kaman, S. (1998). Allelopathic effets of *Ambrosia artemisiifolia* L. on seed germination and seedling growth of field crops. In *Comptes-rendus 6eme Symposium Mediterranean EWRS, Montpellier, France* 1998. pp. 89-90.
7. Bhowmik, P.C. and Doll, J.D. (1980). Evaluation of allelopathic effects of selected weed spp. in corn and soybean. *Proceedings, North Central Weed Control Conference* **34**: 43-45.
8. Bhowmik, P.C. (1982). Allelopathic activity of annual weeds on corn *(Zea mays)* and soybeans *(Glycine max). Dissertation Abstracts International* **B 42**:2637.
9. Bhowmik, P.C. and Doll, J.D. (1982). Corn and soybean response to allelopathic effects of weed and crop residues. *Agronomy Journal* **74**: 601-606.
10. Bhowmik, P.C. and Doll, J.D. (1984). Allelopathic effects of annual weed residues on growth and nutrient uptake of corn and soybean. *Agronomy Journal* **76**: 383-388.
11. Bradow, J.M. (1985). Germination regulation by *Amaranthus palmeri* and *Ambrosia artemisiifolia.* In *The Chemistry of Allelopathy: Biochemical Interactions Among Plants* (Ed., A.C. Thompson). *ACS Symposium Series* No.268: 285-289. Washington D.C: American Chemical Society.
12. Bruckner, D. and Molnar, Z. (1999). The allelopathic effect of *Ambrosia artemisiifolia.* L. on different plant species. In *Proceedings* **11**th *EWRS Symposium* 1999, Basel, Switzerland pp. 74.
13. Coble, H.D. (1979). Common ragweed interference in soybeans. In *Proceedings,* **32***nd Annual Meeting of the Southern Weed Science Society* p. 130.
14. Coble, H.D., Williams, F.M. and Ritter, L.R. (1981). Common ragweed *(Ambrosia artemisiifolia) interference in soybeans (Glycine max). Weed Science* **29**: 339-342.
15. Dalrymple, R.L. and Rogers, J. L. (1983). Allelopathic effects of western ragweed on seed germination and seedling growth of selected plants. *Journal of Chemical Ecology* **9**: 1073-1078.
16. Dickerson, C. (1968). Studies on the germination, growth, development and control of common ragweed *(Ambrosia artemisiifolia* L.). University Microfilms Inc. Ann Arbor, Michigan. 162 pp.
17. Dickerson, C. T .and Sweet, R.D. (1971). Common ragweed ecotypes. *Weed Science* **19**: 64-66.
18. Fischer, N.H. and Quijano, L. (1985). Allelopathic agents from common weeds *Amaranthus palmeri, Ambrosia artemisiifolia* and related weeds. In *The Chemistry of Allelopathy: Biochemical Interactions Among Plants* (Ed., A.C. Thompson). *ACS Symposium Series* No. **268**: 133-147. Washington D.C. American Chemical Society.
19. Frankton, C. and Mulligan, G.A. (1970). *Weeds of Canada.* Canada Department of Agriculture, *Publication* No. *948.* 217 pp.
20. Gebben, A.I. (1965). The ecology of common ragweed *(Ambrosia artemisiifolia* L.) in southeastern Michigan. University Microfilms Inc. Ann Arbor, Michigan. 234 pp.
21. Geissman, T.A., Griffin,S., Waddell, T.G. and Chen, H.H. (1969). Sesquiterpene lactones. Some new constituents of *Ambrosia* species: *A. psilostachya* and *A. acanthicarpa. Phytochemistry* **8**: 145-150.
22. Jackson, J.R. and Willemsen, R.W. (1976). Allelopathy in the first stages of secondary succession on the piedmont of New Jersey. *American Journal of Botany* **63**: 1015-1023.
23. Kobayashi, A., Morimoto, S., Shibata, Y., Yamashota, K. and Numata, M. (1980). C_{10}-polyacetylenes as allelopathic substances. *Journal of Chemical Ecology* **6**: 119-136.
24. Le Tourneau, D., Failes, G.D. and Haggeness, H.G. (1956). The effect of aqueous extracts of plant tissue on germination of seeds and seedlings growth. *Weeds* **4**: 363-368.
25. Le Tourneau, D. and Haggeness, H.G. (1957). Germination and growth inhibition in leafy spurge foliage and quackgrass rhizomes. *Weeds* **4**: 363-368.
26. Medlen, L.L. and Worsham, A.D. (1978). Common ragweed *(Ambrosia artemisiifolia)* interference in flue-cured tobacco. In *Proceedings of 31st Annual Meeting of the Southern Weed Science Society.* p. 242.
27. Muminovic, S. (1990). Allelopathic effects of weed extracts on germination of crop seeds. *Fragmenta Herbologica Jugoslavica* **19**: 93-102.
28. Narwal, S.S. (1994). *Allelopathy in Crop Production.* Jodhpur, India: Scientific Publishers. 288 pp.
29. Neill, R.L. and Rice, E.L. (1971). Possible role of *Ambrosia psilostachya* on patterning and succession in old fields. *American Midland Naturalist* **86**: 344-357.
30. Numata, M., Kobayashi, A. and Ohga, N. (1973). Studies on allelopathic substances concerning the formation of the urban flora. In *Fundamental Studies: Characteristics of Urban Ecosystems.* (Ed., M. Numata) pp. 59-64. Chiba, Japan: Chiba University.
31. Rasmussen, J.A. and Einhellig, F .A. (1979). *South Western Naturalist* **24**: 637-644.
32. Roedel, G.F. and Thornton, M.H. (1942). The composition and properties of ragweed seed oil. *Journal of American Oil Chemical Society* **19**: 153-156.

33. Shurtleff, J.L. and Coble, H.D. (1985). Interference of certain broadleaf species in soybeans *(Glycine max). Weed Science* **33**: 654-657.
34. Singh, U., Wadhwani, A.M. and Johri, B.M. (1983). *Dictionary of Economic Plants in India.* 2nd Edition. New Delhi: Indian Council of Agricultural Research. 288 pp.
35. Toole, E.H. and Brown, E. (1946). Final results of the Duvel buried seed experiment. *Journal of Agricultural Research* **72**: 201-210.
36. Turner, J.A. (1928). Relation of the distribution of certain Compositae to the hydrogen concentration of the soil. *Bulletin of the Torrey Botanical Club* **55**: 199-213.
37. Uphof, J.C.Th. (1968). *Dictionary of Economic Plants.* New York: Verlag Cramer. 591 pp.
38. Wagner, W.H. and Beals, T.F. (1958). Perennial ragweeds *(Ambrosia)* in Michigan, the description of a new, intermediate taxon. *Rhodora* **60**: 177-204.
39. Wei, W., Xinsu, Z. and Weizhi, L. (1998). Influence of ragweed *(Ambrosia trifida)* on plant parasitic nematodes. *Journal of Chemical Ecology* **24**: 1707-1714.
40. Wiersema, J.H. and Leon, B. (1999). *World Economic Plants.* Boca Raton, FL, USA: CRC Press. 749 pp.
41. Zidan, Z.H., El-Deeb, H.I., Wilson, M. and Asran, F.D. (1997). Molluscicidal activity of certain weed extracts and fertilizers against the brown garden snail, *Helix aspersa. Annals of Agricultural Science* (Cairo) **42**: 687-695.